1-2013

2013 Update Mtg: Phosphorus

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Phosphorus!

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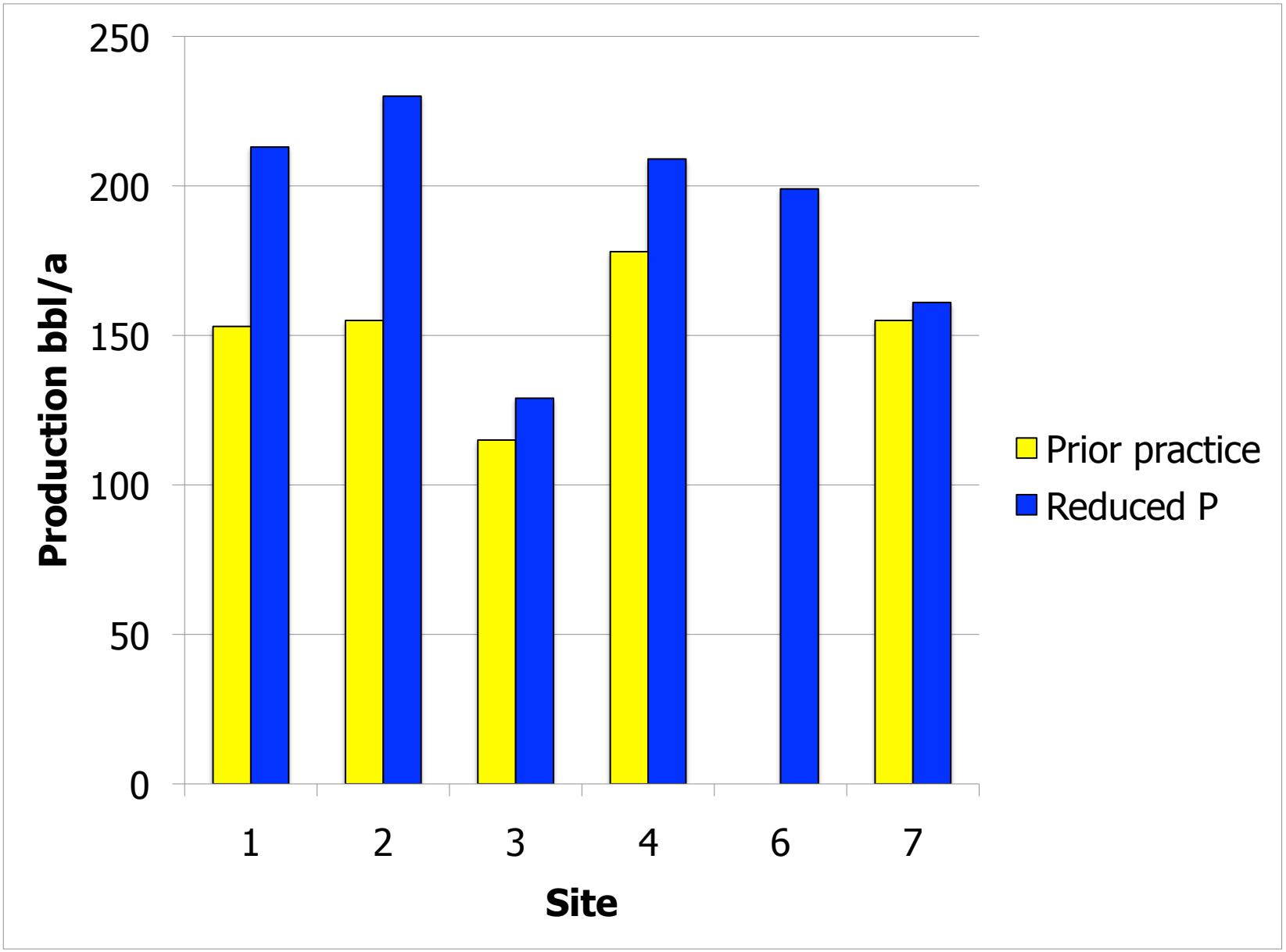
UMass Amherst Cranberry Experiment Station

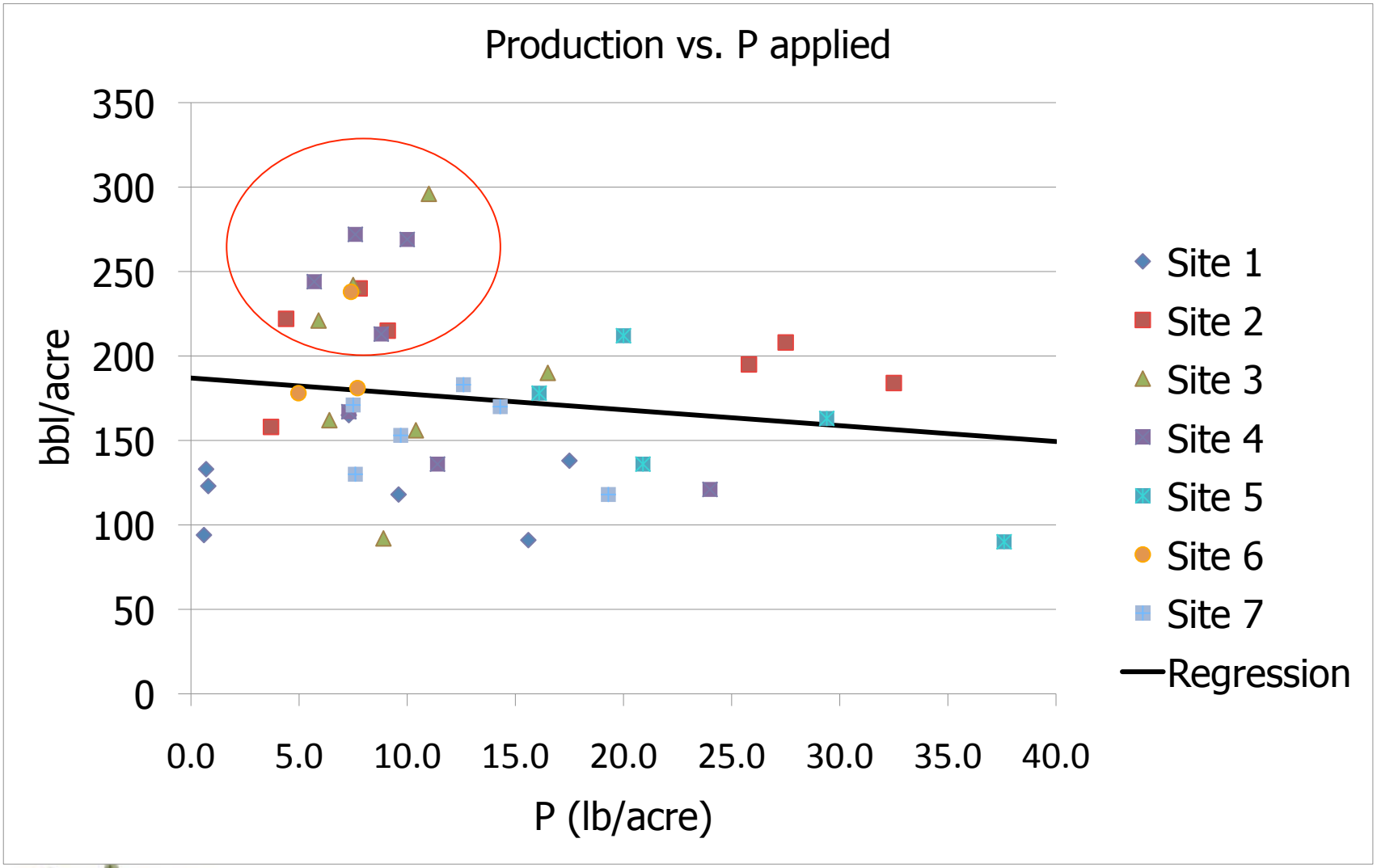
Phosphorus fertilizer use is under scrutiny

- Inland water quality
- TMDL process

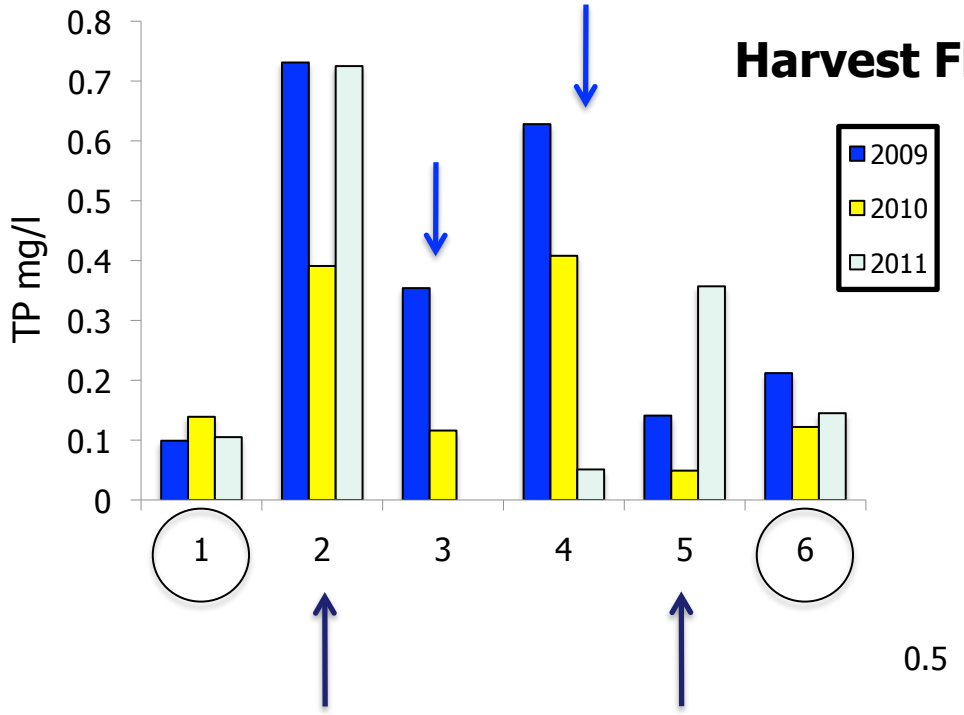
Evidence that cranberry production requires only modest P additions

- Plot scale studies with N and K constant and varied P
  - All P rates (20-60 lb/a) gave greater yield than zero P control but were similar to one another
  - Second study – little effect of any P rate compared to zero
- Whole bog scale grower study with P reduced to ~10 lb/a
  - No negative impact on yield compared to previous practice


250
200
150
100
50
0
Production bbl/a
1
2
3
4
6
7
Site
Prior practice
Reduced P



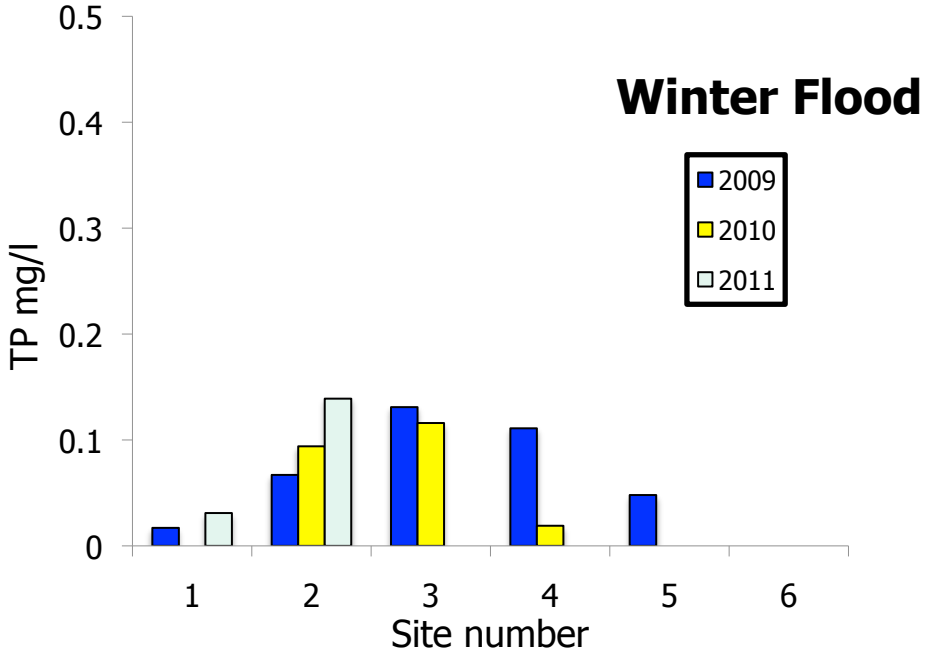
Data from 2005-2011



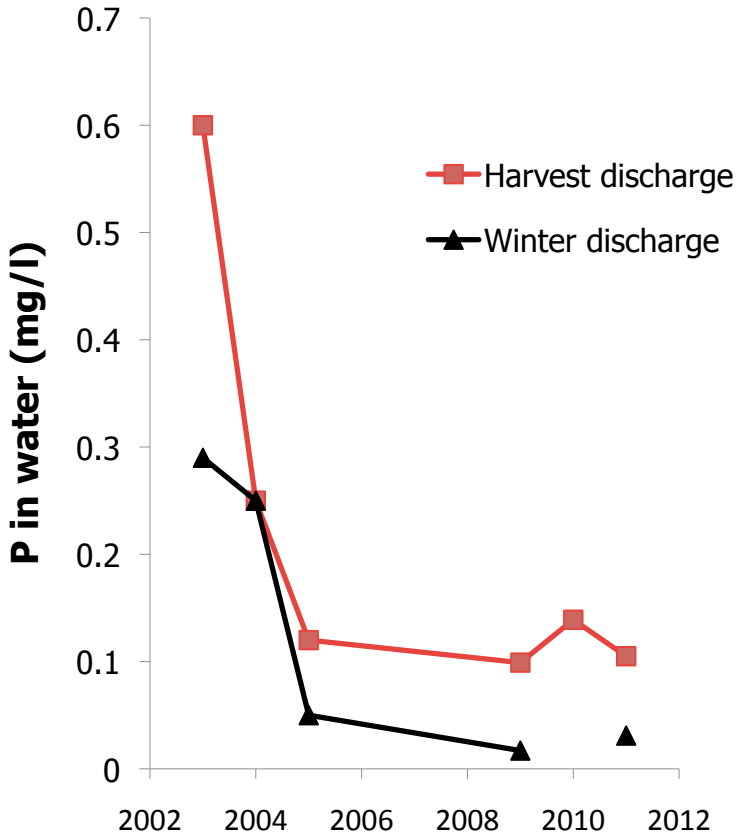
Comparison of TP in flood releases

	Years of P reduction		
Site	2009	2010	2011
1	7	8	9
2	5	6	7
3	2	3	4
4	2	3	4
5	1	2	3
6	3	4	5

Water quality advantage to reducing P



Site 1



Applied P

Pre-2003 = 20 lb/a

Avg. starting 2003 = 10 lb/a

Change (lb/a released)

	Harvest	Winter
Year 1	2.71	1.58
Year 7	0.45	0.09
Year 8	0.63	----
Year 9	0.34	0.04

Potential impact

- Using Site 1 as an example
- Bog is ~60 acres
- In 2003, the 2 floods (winter/harvest) contained 257 lb P
- 8 years later, the floods contained 23 lb P
- >90% reduction

Study of various fertilizer forms to deliver varied P rates

- 2009-2011
- Pilgrim and Howes
- 2 x 2 m plots
- Other than zero control, all treatments received N at 25 lb/a

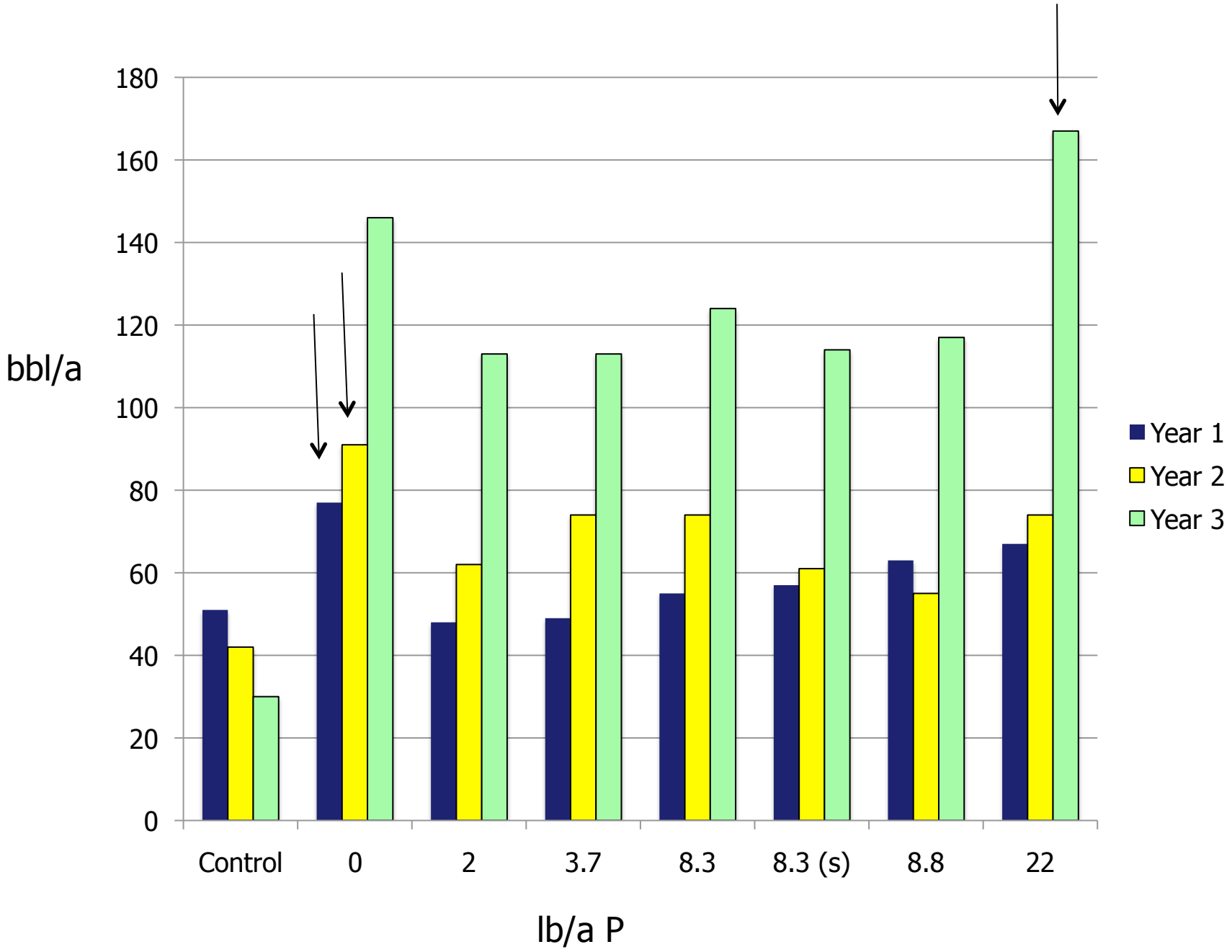
- Fertilizer forms
  - Soluble granular
  - Controlled release – poly coated particles
  - SCU
  - Liquid formulations
- P rates
  - Zero to 22 lb/a

1	Untreated control No fertilizer	
2	8.3 P	3 applications, soluble 5-10-10; 18-8-18
3	3.7 P	2 applications; poly coat, soluble 20-5-8 slow; 18-8-18
4	Zero P	2 applications, soluble 30-0-20
5	2.0 P	2 applications soluble, 6 liquid 30-0-20; Oceans Organic foliar
6	8.3 P	2 applications; slow, soluble 10-12-24 SCU, 18-8-18
7	22 P	2 applications, soluble 5-10-10; 12-24-12
8	8.8 P	3 applications; soluble, hyperP 5-10-10; 16-8-13

Yield data

- Treatment was significant
- Significant Treatment x Year interaction
- No Location x Treatment interaction
- Look at years separately but sites combined

NOTE: no significant differences in fruit rot


180
160
140
120
100
80
60
40
20
0
bbl/a
Year 1
Year 2
Year 3
Control
0
2
3.7
8.3
8.3 (s)
8.8
22
lb/a P

Yields [bbl/a], locations combined

P rate	Year 1	Year 2	Year 3
Control	51	42	30
0	77	91	146
2.0	48	62	113
3.7	49	74	113
8.3	55	74	124
8.3 (s)	57	61	114
8.8	63	55	117
22	67	74	167

Significantly more than 0 P, 25 N

Year 1	Year 2	Year 3
none	none	22 P

What was different in Year 3?

- Look at tissue P
  - Location 1 – all just above critical level [0.1%]
  - Location 2 – all deficient [0.06-0.08%]

- Re-examine yield at each location
  - Both locations, 0 P and 22 P were the highest yield treatments
  - Location 1 - only 2 bbl/a apart
  - Location 2 – 22 P was 40 bbl/a greater than 0 P [interaction with tissue P deficiency]

Similar study on Stevens

- 2010-2012
- Other than zero control, all treatments received N at 25 lb/a
- NO zero P treatment in this one

- Fertilizer forms
  - Soluble granular
  - Controlled release – poly coated particles
  - SCU
- P rates
  - 2.7 to 22 lb/a

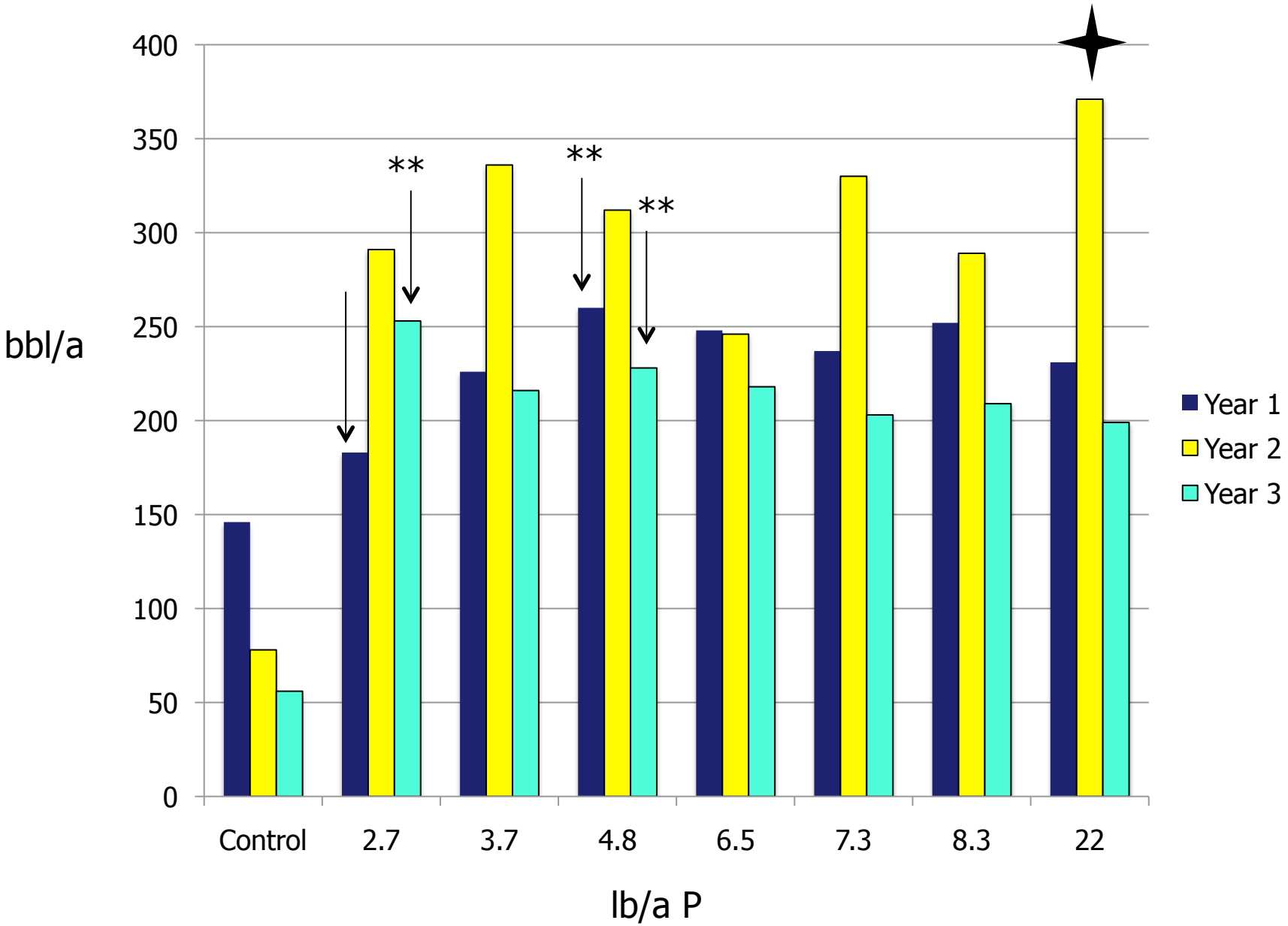
1	Untreated control No fertilizer	
2	8.3 P	3 applications, soluble 5-10-10; 18-8-18
3	3.7 P	2 applications; poly coat, soluble 20-5-8 slow; 18-8-18
4	6.5 P	2 applications; poly coat, soluble 20-5-8 slow; 5-10-10
5	4.8 P	1 application soluble 18-8-18
6	7.3 P	2 applications; slow, soluble 10-12-24 SCU, 18-8-18
7	22 P	2 applications, soluble 5-10-10; 12-24-12
8	2.7 P	1 application; poly coat 20-5-8 slow

Fruit rot on Stevens plots

- Was extremely high at one site all 3 years, at the other in 2011
- Increasing P was NOT associated with less fruit rot
- So we calculated potential yield if there had been no rot and compared that

Potential yield data

- Treatment was significant
- Significant Treatment x Year interaction
- No Location x Treatment interaction
- Look at years separately but sites combined


400
350
300
250
200
150
100
50
0
bbl/a
**
**
**
Year 1
Year 2
Year 3
Control
2.7
3.7
4.8
6.5
7.3
8.3
22
lb/a P

Potential Yield [bbl/a], sites combined

P rate	Year 1	Year 2	Year 3
Control	146	78	56
2.7	183	291	253
3.7	226	336	216
4.8	260	312	228
6.5	248	246	218
7.3	237	330	203
8.3	252	289	209
22	231	371	199

Significantly less than 22P, 25 N

Year 1	Year 2	Year 3
2.7 P	all	none

Significantly more than 22P, 25 N

Year 1	Year 2	Year 3
4.8 P	none	4.8, 2.7 P

What was different in Year 2?

- Look at tissue P
  - Both locations – average across treatments was at the critical level [0.1%]
  - Many individual samples were deficient [0.07-0.09%], especially at Site 2
- Re-examine yield at each location
  - Location 1 - 3.7 and 22 had greatest yield but were only 1 bbl/a apart
  - Location 2 – 22 P was 30 bbl/a greater than 7.3 P

Summary

- Cranberry yield was not sustained in the absence of nitrogen
- In the absence of tissue P deficiency, there was no yield response to increasing P rates regardless of fertilizer form
- When tissue P is sufficient there is often no yield response to any P rate